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Vocal Rehabilitation after Partial or Total Laryngectomy

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■ *One of the paramount concerns of a patient who must undergo surgical intervention for laryngeal cancer is the effect on his speech. The type of operation is based on the anatomic extent of the cancer, but each procedure presents inherent problems in vocal rehabilitation. Glottic incompetence is the primary deficit to be overcome following hemilaryngectomy, whereas the aspirate voice is the principal problem with supraglottic laryngectomy. When the larynx must be sacrificed by total laryngectomy, the patient attempts to learn esophageal speech. If this fails, a vibrating sound source for speech can be acquired, either by the construction of a trachealpharyngeal communication or by use of a manual electric vibrator.*

WHEN A PATIENT MUST BE TOLD that he has a laryngeal cancer, the devastating impact can be softened by reassurance that he has a good prognosis for life and an excellent outlook for speech after treatment. More than half of these patients can be treated by irradiation or by a surgical procedure that will spare one or both vocal cords. The others will require total laryngectomy but even then methods of speech without a larynx usually may be acquired with proper training.

Small, superficial vocal cord cancers commonly are treated by irradiation, usually without significant change of the quality of the voice. The patient may experience vocal fatigue, slight involuntary changes in vocal pitch, and impairment of precision vocalization such as singing. The patient should be counseled in proper vocalization and cautioned against vocal abuse.

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More extensive cancers confined to the vocal cords are best treated by hemilaryngectomy. Since most vocal cord cancers are well differentiated and not deeply infiltrating, the surgeon can often spare the arytenoid cartilage of the involved vocal cord, improving the patient's chances for good vocal rehabilitation. Glottic closures may be accomplished by the remaining vocal cord, provided there is sufficient tissue filling the defect of the excised vocal cord. Various methods for providing adequate tissue (pseudocord) in the area of the excision have utilized muscle[1] and cartilage implants,[2] pyriform sinus mucosal flaps,[3] and cervical skin flaps.[4]

Success in vocalization depends largely on how straight and to what extent the pseudocord approaches the midline. Normal phonation requires complete approximation of the edges of both vocal cords. Injection of polytef (Teflon®) paste has proved to be very effective in filling irregularities and displacing the pseudocord to the midline.[5] Web formation or granulation tissue

within the laryngeal lumen occasionally hampers vocal rehabilitation. Granulation tissue can be removed by simple excision, but the webbing may require use of a temporary intralaryngeal keel.

It is well known that the remaining vocal cord is capable of crossing the midline by one to two millimeters during phonation. This overcompensation can be augmented by certain vocal exercises which stimulate vocal cord abduction. Controlled coughing, strong phonation of select syllables such as "kik," and staccato vocalization of vowels all produce this effect. Pushing exercises described by Froeschels and associates[6] are based on reflex vocal cord abduction that occurs with certain motions of the arms and shoulder girdle. With strenuous arm pushing and pulling, glottic closure helps stabilize the thoracic cage. Similarly, vocal cord adduction can be elicited by instructing the patient to clasp his hands at chest level and then forcibly to push them downward while phonating "ah," or by having the patient push against an immovable object while phonating.

Limiting the Length of Phrases

Despite incomplete glottic closure with premature exhaustion of breath supply, most patients attempt word phrases of the length to which they were accustomed before they were operated upon. Consequently, each phrase ends in a forced whisper. The speech therapist stresses maximal inhalation, controlled exhalation, and shortened word phrases to help provide a more normal speech. The patient's pitch range is sampled to determine whether a particular pitch is less hoarse and strained. Early in therapy, maneuvers such as turning the head or pressing manually on the side of the neck improve phonation.

Cancers that arise above the vocal cords in the larynx and pharynx often can be extirpated by a supraglottic laryngectomy which spares the vocal cords (Figure 1). The patient who has an operation of this type may anticipate a nearly normal voice. There may be a loss of vocal pitch range, particularly in the upper registers, because of the necessary section of the nerve to the cricothyroid muscle which tenses the vocal cords. Occasionally the voice will have an aspirate quality due to oropharyngeal secretions on the vocal cords resulting from the loss of the supraglottic sphincteric action of the epiglottis and aryepiglottic folds. The patient usually can clear these secretions by exhaling slightly before speaking. A surgical method of tilting the larynx posteriorly 45 degrees by suture suspension to the mandible recently has been devised which augments spill-off of secretions on the vocal cords.[7]

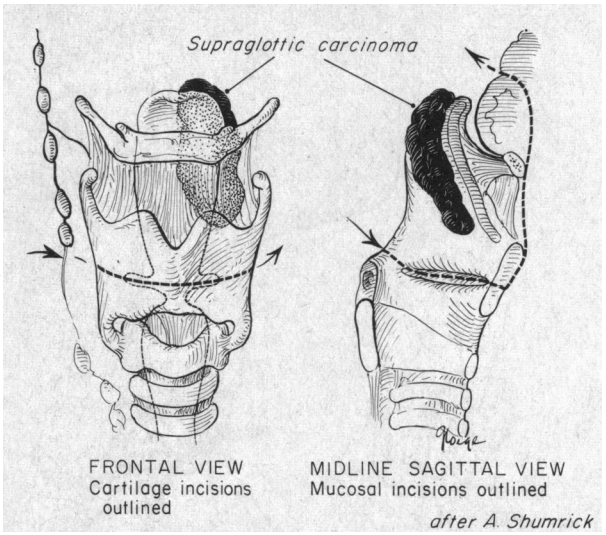

Figure 1.—Schematic views of the area of excision by supraglottic laryngectomy.

After Total Laryngectomy

Extensive cancers of the larynx that cannot be cleared by partial laryngectomy require total laryngectomy. Any method of vocal rehabilitation after total sacrifice of the larynx must produce a vibrating air column which can be formed into words by the articulating organs of the oral cavity. The most popular method of vocal rehabilitation is esophageal speech which utilizes the sphincter of the esophageal inlet as a vibrating sound source. The patient is trained to force air into the upper esophagus in a swallowing action and to release this air in a controlled manner through the cricopharyngeal sphincter which acts as a vibrating "pseudoglottis." The resultant speech is remarkably similar to normal laryngeal speech.

Low fundamental pitch and weak intensity are two major limitations of esophageal speech that undermine speech intelligibility. To alleviate these problems, the speech therapist trains the patient to phonate at average pitch levels (above 60 cycles per second) and, in addition, to fluctuate vocal pitch and intensity in order to relieve the monotony inherent in esophageal speech. Some esophageal speakers achieve a

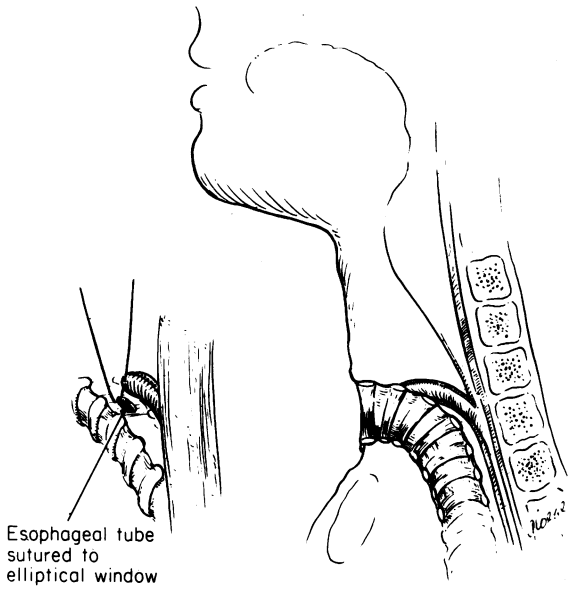

Figure 2.—The esophageal tube is sutured to a window excised in the trachea. A vibrating air column enters oral cavity through the esophageal tube.

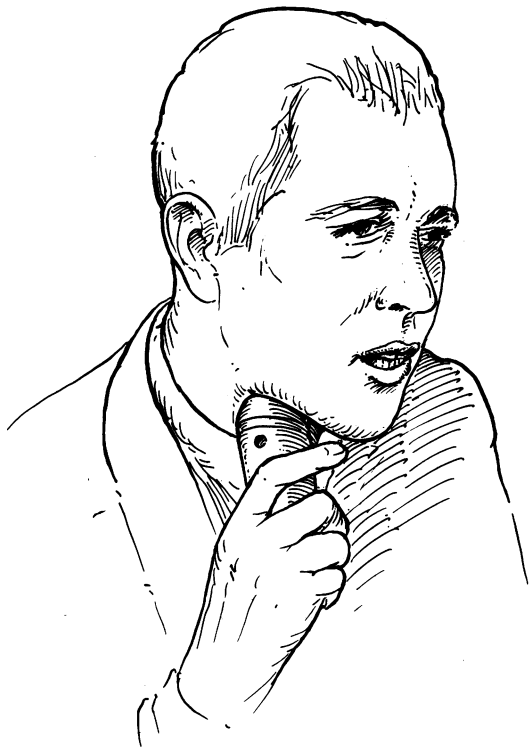

Figure 3.—The vibrating head of the electrolarynx is placed against the neck. The resultant tone is articulated into words by the oral cavity.

vocal range of one octave. Since a limited volume of air can be expelled by the esophagus, the number of words between air intakes is a good deal less than with normal speech. The esophageal speaker is trained to limit words per phrase to five, rather than to end longer phrases in a forced whisper. This limited air supply also compromises sibilant consonants such as "s" and "sh," and there is complete loss of the "h" sound at the beginning of a syllable. Facial grimacing and the noise of esophageal air intake are other problems which the patient frequently can be trained to overcome.

If Esophageal Speech Fails

Despite adequate speech rehabilitational training, only 50 percent of persons who have had laryngectomy learn intelligible esophageal speech.[8] The training usually requires three to six months. The most common cause of failure to acquire speech of this type is an inability to achieve adequate relaxation of the esophageal sphincter, which can be restricted by scarring, severed nerve supply, or extensive surgical resection. Pharyngolaryngectomy or heavy irradiation to the cervical esophagus usually precludes acquisition of esophageal speech. Impaired hearing will interfere with the monitoring of speech, and frailty or old age make esophageal speech extremely difficult. Certain sequelae of esophageal speech related to air ingestion that may hamper its successful use include abdominal distension, excessive flatulence, and even gastric or duodenal ulceration.

For patients who are not likely to learn esophageal speech, surgical procedures have been devised to generate a vibrating column of air sufficient for speech. It is known that if a communication can be developed between the trachea and pharynx, the vibration of air through this passage can be used for word production. Mechanical devices with a vibrating reed were used for a time but were discarded because of poor tissue tolerance.

Conley[9] used an autogenous vein graft, and Asai[10] constructed a cervical skin tube to create an air communication between the trachea and pharynx. By plugging the tracheostoma temporarily, the patient, on exhalation, is able to phonate with nearly normal quality. With both procedures, early success has been achieved in voice production; however, stenosis and aspiration through the communication have limited their use in many patients. One of the authors[11] has tested a full-thickness esophageal tube both

clinically and in the laboratory that appears to solve the long-term problem of aspiration and stenosis (Figure 2).

The Electrolarynx

The sound source also may be generated by a battery-powered vibrating instrument called an artificial larynx or electrolarynx. The individual speaks by placing the vibrating head of the instrument against the side of his neck and articulating words with the tongue and oral cavity (Figure 3). Although the intelligibility is acceptable, many patients refuse this type of rehabilitation because of the unnatural mechanical quality of the resultant speech.

Early use of an electrolarynx remains a controversial subject. Some speech therapists feel that early reliance upon the electrolarynx will decrease motivation in the often arduous acquisition of esophageal speech. Contrasted against this consideration is the psychological impact of protracted silence and the economic necessity of resuming employment. We feel that the instrument need not interfere with esophageal speech, provided the patient undertakes early and regular speech therapy.

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ON BLEEDING AND REPLACEMENT AND BALDERDASH

The old axiom that if you bleed whole blood you should return whole blood is pure balderdash. Blood contains a variety of cells and a huge variety of proteins. If you make the assumption that when you bleed whole blood you are bleeding elements of equal life span, equal turnover rate, equal excess over physiologic need, equal degree of reserve, and equal "handleability" in the bottle or bag, then you would be quite right in stating that if you bleed whole blood you should return whole blood.

But actually whole blood contains red cells that live for four months, white cells that live for four hours, platelets which live for a week but are in enormous reserve (as are the granulocytes while red cells are in no reserve) . . ., and plasma proteins that have life spans of anywhere from a couple of days to a couple of months. What is more, these elements, when removed and placed in a storage container, may have a lifespan of hours. As a matter of fact if you take leukocytes from fresh whole blood, most are dead within a matter of several hours. Of those still alive at the time of retransfusion, 90 percent do not survive. On the other hand, if red cells are taken fresh from an individual and returned the same day, virtually 100 percent survive. Platelets are somewhere in the middle; about 50 percent survive. That being the case if one has a massive bleed and attempts to correct it with whole blood, at least half the platelets are lost in storage and a little bit more if the blood is more than four or five hours old.

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